

Claims

1. Beam current measuring apparatus comprising:
5 a magnetism shielding part for shielding an external magnetic field; and
a magnetic field sensor arranged in the shielding space generated by said
magnetism shielding part, said beam current measuring apparatus measuring, by using said
magnetic field sensor, a magnetic field where a beam current to be measured is generated,
wherein said magnetic field sensor has a magnetic flux/feedback current
10 conversion coefficient of 8×10^{-15} Wb/A or above.
2. The beam current measuring apparatus according to claim 1, wherein
said magnetic field sensor has a magnetic flux/feedback current conversion coefficient of 2
 $\times 10^{-12}$ Wb/A or below.
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3. The beam current measuring apparatus according to claim 1 or 2,
wherein said magnetic field sensor has a magnetic flux/feedback current conversion
coefficient of 1×10^{-12} Wb/A or below.
- 20 4. Beam current measuring apparatus comprising:
a magnetism shielding part for shielding an external magnetic field; and
a magnetic field sensor arranged in the shielding space generated by said
magnetism shielding part, said beam current measuring apparatus measuring, by using said
magnetic field sensor, a magnetic field where a beam current to be measured is generated,
25 wherein said magnetic field sensor has a magnetic flux sensitivity of 2×10^{-18}
Wb/V or above.
5. The beam current measuring apparatus according to claim 4, wherein
said magnetic field sensor has a magnetism sensitivity of 5×10^{-15} Wb/V or below.
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6. The beam current measuring apparatus according to claim 4 or 5,
wherein said magnetic field sensor has a magnetic flux sensitivity of 2×10^{-15} Wb/V or

below.

7. The beam current measuring apparatus according to any one of claims 1 through 6, wherein said magnetic field sensor is a SQUID.

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8. The beam current measuring apparatus according to any one of claims 1 through 6, wherein said magnetic field sensor is a high-temperature superconducting SQUID.

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9. The beam current measuring apparatus according to any one of claims 1 through 8, wherein said magnetic field sensor comprises a magnetism shielding part for magnetically shielding from an external magnetic field a sensor part that senses magnetic flux to be measured.

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10. The beam current measuring apparatus according to claim 9, wherein said magnetism shielding section comprises a superconductor.

11. The beam current measuring apparatus according to claim 9, wherein said magnetism shielding section comprises a high-temperature superconductor.

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12. The beam current measuring apparatus according to claim 10 or 11, wherein said magnetism shielding section comprises a gap.

13. The beam current measuring apparatus according to any one of claims 1 through 12, wherein said magnetic field sensor comprises an electric field shielding part for shielding from an external electric field a sensor part that senses magnetic flux to be measured.

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14. The beam current measuring apparatus according to any one of claims 1 through 13, wherein said magnetism sensor comprises a mechanism for collecting a magnetic field generated by a beam current to be measured.

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15. The beam current measuring apparatus according to claim 14, wherein
said mechanism for collecting a magnetic field is a coil including a superconducting wire
wound around a core of a soft magnetic material or a cylinder whose surface is coated with
a high-temperature superconductor and whose outer periphery has a bridge part partially
5 including a high-temperature superconductor.

16. A beam current measuring method using the beam current measuring
apparatus according to any one of claims 1 through 15, comprising the step of:
arranging a magnetic field sensor of said beam current measuring apparatus on a
10 beam line irradiated from an ion source or an electron ray source onto the surface of a
processed substance in order to measure the beam current value of said beam line from the
output of said magnetic field sensor.

17. A beam irradiation method comprising a measuring step of measuring, by
15 using the beam current measuring method according to claim 16, a beam current of a beam
generated using an ion source or an electron ray source,
a control step of feeding back said beam current value obtained in said measuring
step to the control parameter of said ion source or electron ray source, and
an irradiating step of irradiating a beam current onto a processed substance, said
20 beam current controlled using the control parameter obtained in said control step.

18. Beam irradiation apparatus comprising the beam current measuring
apparatus according to any one of claims 1 through 15.

25 19. A processed substance manufactured using ion implantation apparatus,
electron beam exposure apparatus or accelerating apparatus comprising the beam current
measuring apparatus according to any one of claims 1 through 15.